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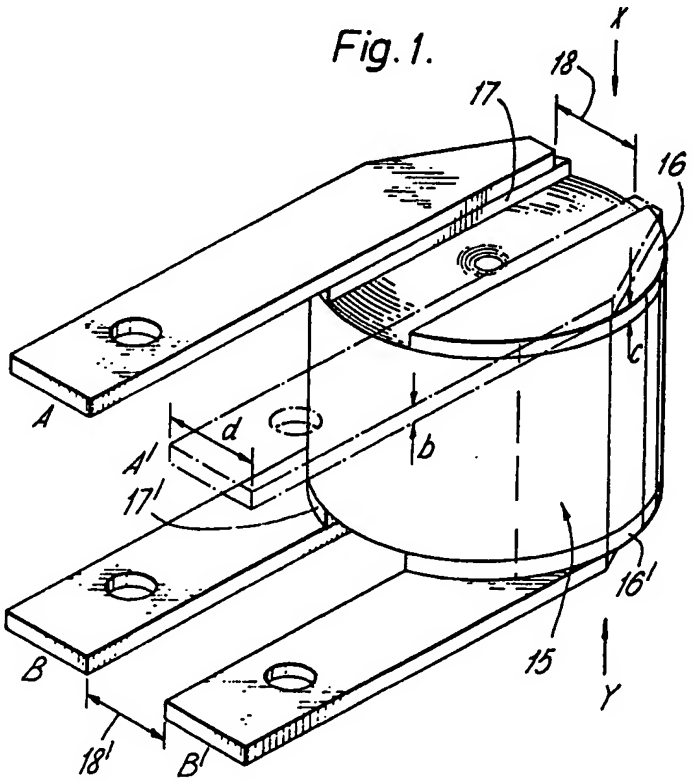
(54) Multi-terminal interference suppression capacitor

(57) A capacitor for filtering out interference from the drive circuit of an electric railway vehicle, comprises a series wound capacitor roll with one electrode projecting from one side (X) and the other electrode projecting from the opposite side (Y), and pairs of external connection terminals (A, A', B, B') soldered to metal sprayed portions (16, 17, 16', 17') of the projecting electrode edges, so that the vehicle drive current (1000A) will be carried by one electrode set via terminals (A, A') and either open circuit or short circuit condition in the capacitor will be a fail safe condition for the vehicle.

Fig. 1.



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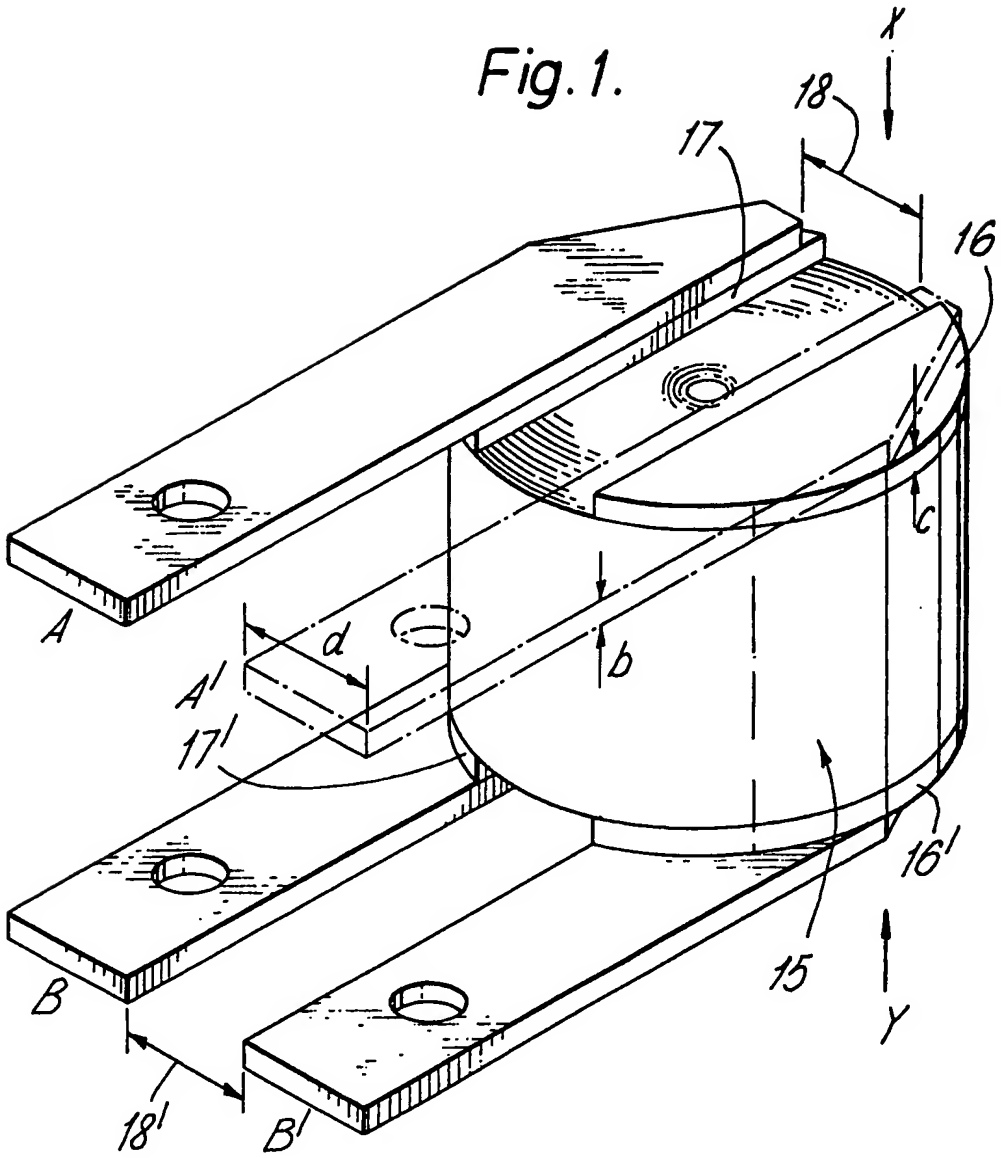
The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

Fig. 1.



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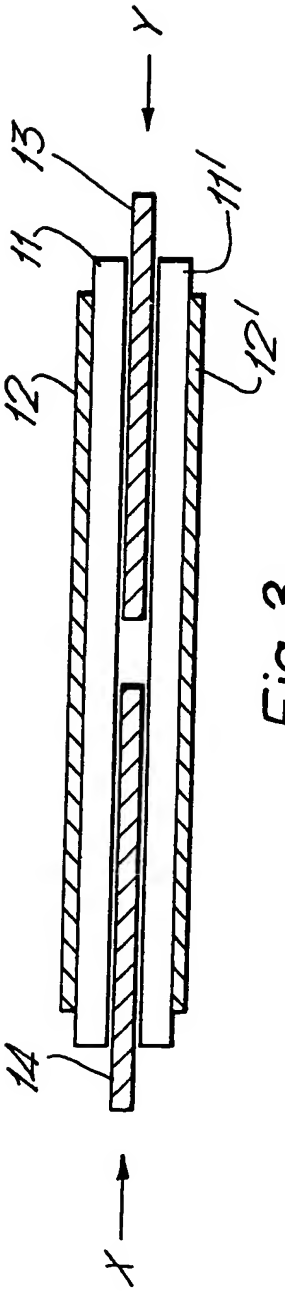

Fig.2.

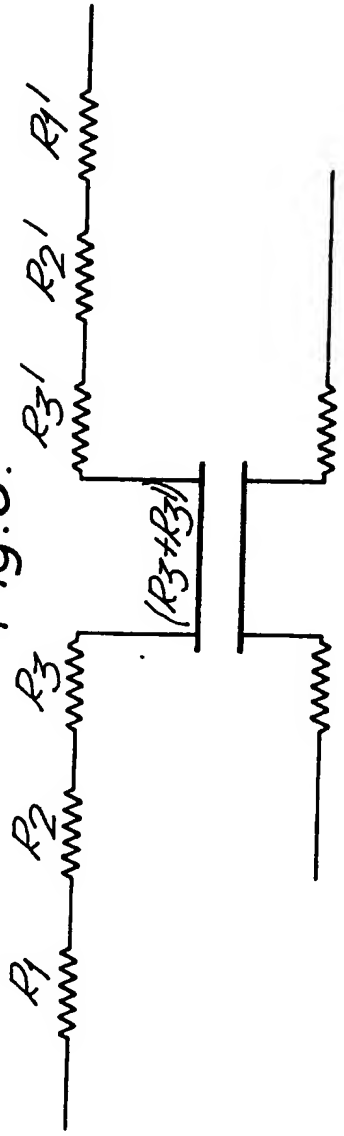

Fig.3.

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SPECIFICATION

Interference suppression capacitor

This invention relates to an interference suppression capacitor.

According to the present invention there is provided a wound foil capacitor having two electrode sets which are exposed on respective opposite sides of the winding, two external connection terminals connected to spaced positions on the exposed adge of one electrode set, and at least one further terminal connected to the exposed edge of the other electrode set, wherein in use of the capacitor the two terminals can be connected in the D.C. supply path of an electrically driven vehicle such as to filter out interference frequencies in the D.C. supply path and wherein a D.C. supply current will pass through the one electrode set via said two terminals.

Conveniently the capacitor is series wound and has four terminals, two terminals connected to spaced positions on one electrode set, the other two terminals connected to spaced positions on a second electrode set.

Preferably the capacitor comprises a first metal foil on one side of a first dielectric layer, a pair or spaced metal foils on the other side of the dielectric layer, a second dielectric layer on the other side of the pair of metal foils, and a second metal foil on the other side of the second dielectric layer, the foils and layers being wound into a roll, and wherein two terminals are connected to the extended edge of one of the pair of metal foils, the other two terminals being connected to the extended edge of the other foil of the pair of foils.

Preferably the dielectric layers are polyester (polyethelene teraphthalate) the foils are aluminium and the terminals are copper plates.

Preferably too a metallic interface is provided between the electrode edge and the connection terminals. In a preferred embodiment the extended edges are sprayed with zinc with the centre section masked, followed by tin zinc spray, and the terminals are soldered to the tin zinc. In order that the invention can be clearly understood reference will now be made to the accompanying drawings, in which:

Figure 1 shows diagrammatically a capacitor according to an embodiment of the present invention;

Figure 2 shows the winding arrangement of the capacitor of Fig. 1, and

Figure 3 shows the equivalent series resistane of the capacitor of Fig. 2.

The capacitor to be described is for an electric railway vehicle having drive motors with associated field winding and series windings.

D.C. power picked up from adjacent floating live and neutral sources is fed to a motor power circuit having thyristors which are controlled by a control circuit to drive the motors at the required speed. Motor control contactors are closed to drive the vehicle and breaking control contactors are closed in order to brake the vehicle using the motors as generators. In this mode interference from the thyristors in the form of harmonics is worse and lies in the range 1.5 KHz to 5KHz. Within this range can lie the frequency of operation of e.g. a railway signalling system and by inductive coupling between the supply rails or wires and the nearby signalling lines, the interference can upset the signalling. This of course can be dangerous, and is particularly significant at points changeover locations. It is required to filter out the interference in a fail safe manner and the capacitor to be described has been developed for this task.

The capacitor is series wound and has four terminals A, A′, B, B′. The electrode set connected to A, A′ is designed to carry the full current of the vehicle power circuit in the neutral line and should either electrode set fail e.g. go open circuit, then either the current no longer reaches the vehicle motors (electrode failure of terminals A, A′) in which case the vehicle stops or, alternatively, if the other electrode fails, (terminals B,B′) which is providing earth continuity for the control circuit, then the earth continuity for the control circuit also fails and this can be sensed to adopt a fail safe mode and stop the vehicle. In the event of a capacitor short circuit then local heating will almost immediately cause an open circuit which is a fail safe mode by the reasons just described.

The capacitor roll is constructed as follows.

Referring to Fig. 2, dielectric layers 11, 11′ are sandwiched between vapour deposited aluminium or zinc foil layers 12, 12′. Sandwiched between the dielectric layers is a pair of discrete aluminium foils 13 and 14 separated by an 8mm gap. Foils 13 and 14 could alternatively be of tin. This pair of foils is of sufficient thickness typically 20 microns to pass the required current without overheating.

The aspect ratio of the roll i.e. diameter to width, is such as to ensure satisfactory current capacity through the winding 15. This ratio can be between 2:1 and 4:1 and is preferably 3:1. The roll is then metal sprayed onto exposed electrode edges on each of the sides X, Y (Fig. 1) with zinc and tin zinc, indicated by reference numerals 16 and 17 (side X on to foil 14) and 16′ and 17′ onto foil 13 (side Y). An open current path 18, 18′ on each side allows for current to pass through the electrode of the roll.

Terminals A, A′ are connected to foil 14 and terminals B, B′ are connected to foil 13. These terminals are formed by tinned copper plates having dimensions d = 50mm, b = 6mm, and the thickness of the zinc and tin zinc connection layers is about 5.0mm. The gap 18, 18′ for the current path is about

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60mm.

Referring now to Fig. 3, the equivalent series resistance of one side of the capacitor is shown. It comprises resistance R1 representing the copper bar terminal, e.g. A, resistance R2 representing the disimilar metal interfaces tin/copper (17), solder, tin zinc, zinc, aluminium and resistance R3 represents the resistance of the aluminium foil (14). Similarly resistance is R3', R2' and R1' represent the corresponding resistance associated with the other terminal A' connected to the same foil (14). In the embodiment described the six series resistances amounts to approximately 0.03 Milliohms. This gives 30W dissipation at a 1000 Amps.

The capacitor roll is housed in an open topped metal case and the internal gaps between the roll and the case filled with a high-dielectric resin. The terminal ends A, A', B, B' project from the open end of the case and are insulated with plastic insulating sleeves projecting above the surface of the potting resin to provide an increased leakage path from the terminals to the edge of the metal casing.

The capacitor has a capacitance of 4.7 Microfarad and a working d.c. voltage of 1500 volts.

The preferred dielectric (polyester) is 36 microns thick and 65mm wide metallised with edge margins of 2.5mm. Alternative dielectrics are Polypropylene, Polycarbonate and Paper. Paper needs impregnating leading to possible termination difficulties at the required voltages (5000 volts peak). Polypropylene would require a larger roll owing to its lower permittivity.

Without the requirement for sensing earth continuity through the capacitor terminals B, B', the capacitor could have a single terminal to replace terminals B, B'.

CLAIMS

1. A wound foil capacitor having two electrode sets which are exposed on respective opposite sides of the winding, two external connection terminals connected to spaced positions on the exposed edge of one electrode set, and at least one further terminal connected to the exposed edge of the other electrode set, wherein in use of the capacitor the two terminals can be connected in the D.C. supply path of an electrically driven vehicle such as to filter out interference frequencies in the D.C. supply path and wherein a D.C. supply current will pass through the one electrode set via said two terminals.

2. A capacitor as claimed in claim 1 having two said further terminals connected to spaced positions on the second electrode set.

3. A capacitor as claimed in claim 1 or claim 2, wherein the foils are series wound.

4. A capacitor comprising a first metal foil on one side of a first dielectric layer, a pair of spaced metal foils on the other side of the dielectric layer, a second dielectric layer on the other side of the pair of metal foils, and a second metal foil on the other side of the second dielectric layer, the foils and layers being wound into a roll, and wherein two spaced-apart terminals are each connected to the extended edge of one of the pair of spaced metal foils, at least one other terminal being connected to the extended edge of the other foil of the pair of foils.

5. A capacitor as claimed in any preceding claim wherein the dielectric layers are polyester and the foils are aluminium and the terminals are copper plates.

6. A capacitor as claimed in any preceding claim, wherein an electrode set has an exposed edge sprayed with zinc followed by a tin zinc spray, and the terminals are soldered to the tin zinc.

7. A capacitor substantially as herein before described with reference to Fig. 1, Fig. 2 and Fig. 3 of the drawings.

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